

HV 1669
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BRAILLE CHEMICAL NOTATIONS

and

HOW TO USE THEM

(For American Texts)

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1959

HV 1669
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Madeleine Seymour Loomis



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BRAILLE CHEMICAL NOTATIONS

and

HOW TO USE THEM

By

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Dedicated to Augustine J. Smith, Vice-President of the
Board of Managers, who has for over a decade
served the blind children of
The New York Institute for the Education of the Blind

HV 1669
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PREFACE

This monographic work is the eighth of a series of contributions to the literature on methods of the education of the blind.

The aim of this series is to make available, to workers and students in the field of education of the blind, the literature from other languages and worthwhile English publications dealing with the methods of teaching the blind. The Board of Managers, in making this series possible, presents the view of each author as the author's opinion and not the opinion of the Board of Managers of The New York Institute for the Education of the Blind. In some cases it is possible that the philosophy and general educational policy of the school may be quite different from the view expressed by the author of the monograph.

In this monograph, Miss Loomis and Mr. Mitchell have created a new and unique method of instructing our blind child in the subject material which has been the most difficult to teach of all of our content subjects. A careful study of the monograph will give the reader some indication of the real problems that the authors faced in the preparation of the material and in working out a practical, usable method.

I consider this monograph one of the outstanding contributions of all times to the teaching of subject matter to handicapped children.

M. E. FRAMPTON, Principal
The New York Institute for the
Education of the Blind
999 Pelham Parkway
New York City

January 1, 1939

FOREWORD

The publishing of scientific books for class room use has progressed so rapidly in the last few years that it has become necessary to devise new Braille symbols in order to write modern forms of chemical equations used in these recent texts. Up to this time, the only guide for any chemical notation has been *Mathematical and Chemical Notation*, by H. M. Taylor, published in 1917. The most recent addition to the list of chemistry books recommended for Braille is *First Principles of Chemistry*, by Brownlee-Fuller-Hancock-Sohon-Whitsit (Allyn and Bacon, 1938). This book uses twelve or more symbols not covered by Taylor's *Mathematical and Chemical Notation*.

During the past three years of class and laboratory work in chemistry at the New York Institute for the Education of the Blind, it was necessary to devise symbols to follow the methods used in modern texts. These symbols have been selected with great care, used under actual laboratory conditions, and have served well in preparing pupils for college entrance and State examinations—the New York State Regents examinations.

The final results, as enumerated in this monograph, are drawn from the English system of Braille, the German, the American usage of Braille, and from suggestions made by pupils and other interested persons.

The most radical departure from the English system is the recommended use of the capital sign (consistent with American usage under all other conditions) and the dropping of the sub-one after the single atom. Blind pupils are coming more and more to the use of the typewriter and script for written communication with the sighted. The typewriter is relied upon for high-school, Regents, and college examinations. Since the use of the capital sign prepares the pupil for correct writing of ink-print (typing), it is more desirable to use it in the Braille chemical equation. The symbol and rule for expressing the electron have been adopted for the same reason although it involves the use of a compound sign.

The method of using arrows is selected from the German and is well liked by pupils of chemistry. It does not preclude the use of the equality sign as written in some texts. Unless the pupil's typewriter is especially fitted with the +, and =, it will be necessary to use the words "plus," and "equals," to properly write chemical equations. It should be observed, as an aid to memory, that the regular arrow is transformed into a heavy one by the addition of dot 2 to the original sign,

whenever possible; this has been possible in all but one case in which the sign already contained dot 2.

The dot numbers in this monograph conform to the arrangement adopted in 1932 for Standard English Braille: the left-hand dots are 1, 2, 3 and the right-hand dots are 4, 5, 6. Thus the dot 5 of H. M. Taylor's *Mathematical and Chemical Notation* and the dot 3 in this pamphlet are one and the same.

These rules and symbols *do not* in any way conflict with any previous rule in the use of Braille in the United States. They are suggested as an addition to make the Braille list more adequate for the present; they are additions rather than alterations. Most of the signs used for the Braille chemical symbols are new; the rules have been drafted to suit the needs of the American students and give them the best possible conception of the equations as they appear in ink-print.

New York City
January 1, 1939

M. S. L.
P. C. M.








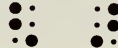
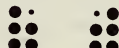
































THE SIXTY-THREE BRAILLE SIGNS ARRANGED IN
SEVEN LINES

[illegible][illegible][illegible][illegible][illegible]

6th	1 • ●4	1 • ●4	1 • ●4	1 • ●4	1 • •4	1 • •4
Line	2 • •5	2 • •5	2 • ●5	2 • ●5	2 • •5	2 • •5
	3 ● •6	3 ● ●6	3 ● ●6	3 ● •6	3 ● •6	3 ● ●6

7th	1 • ●4	1 • ●4	1 • ●4	1 • •4	1 • ●4	1 • •4	1 • •4
Line	2 • •5	2 • ●5	2 • ●5	2 • ●5	2 • •5	2 • ●5	2 • •5
	3 • •6	3 • •6	3 • ●6	3 • •6	3 • ●6	3 • ●6	3 • ●6

SIGNS USED IN CHEMICAL NOTATION

Change to a lower line 	Change to an upper line 	Minus — 	Plus + 	Equality sign = 	
Proportion sign * : 	Proportion sign :: 	Parenthesis () 	Brackets [] 		
Single bond 	Double bond 	Triple bond 	Quadruple bond 	Electron <i>e</i> 	Multiplication sign × 
Division sign ÷ 	Precedes marks of punctuation following formulae 		 	 	
 	 	 	 		
 	 	 	 	 	 

*Sometimes called ratio sign.

BRAILLE

CHEMICAL NOTATION FOR AMERICAN TEXTS

SYMBOLS AND RULES

- I. In any compound, the number of atoms of any element is denoted by the Braille signs of the fifth line of Standard English Braille (see page 6), the number being attached to the symbol of each element, except in the case where the element indicated has but one atom in the compound. For example, $\begin{smallmatrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \end{smallmatrix}$ stands for a molecule of water, which has two atoms of hydrogen and one atom of oxygen. Sugar, $C_{12}H_{22}O_{11}$, is written



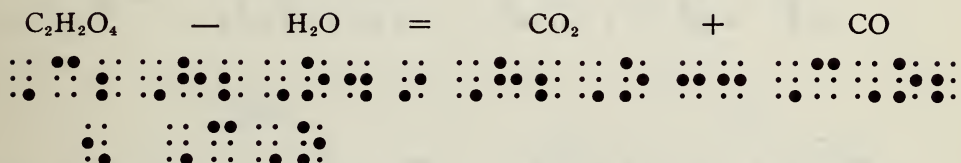
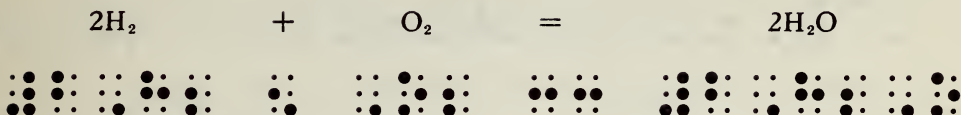
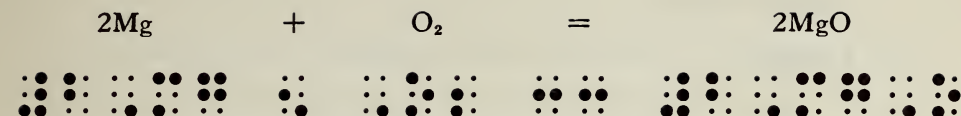
and Hexane, C_6H_{14} , is written $\begin{smallmatrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \end{smallmatrix}$

The capital sign is used as in ink-print.

Ordinary numerals on the regular line are expressed the same as in Standard English Braille, hence $2H_2O$ is written $\begin{smallmatrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \end{smallmatrix}$

- II. In writing equations, the usual arithmetical signs for *plus* (+) $\begin{smallmatrix} \cdot\cdot \\ \cdot\cdot \end{smallmatrix}$, *minus* (—) $\begin{smallmatrix} \cdot\cdot \\ \cdot\cdot \end{smallmatrix}$, and *equals* (=) $\begin{smallmatrix} \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot \end{smallmatrix}$ may be used. These signs must be preceded and followed by a space.

Examples :



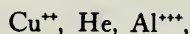
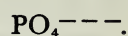
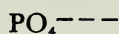
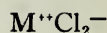
III. Dot 3, $\ddot{\cdot}$, is placed immediately after the formula of a compound when it is followed by a punctuation mark. When an atom, or group of atoms, carries an electric charge (becoming an ion) the symbol of the atom, or group of atoms, is followed by dot 3, and the sign for *plus*, $\ddot{\cdot}$, or *minus*, $\ddot{\cdot}$. For example, $\ddot{\cdot}\text{H}\ddot{\cdot}$, stands for H^+ (an ion of hydrogen) and $\ddot{\cdot}\text{Cl}\ddot{\cdot}$ stands for Cl^- (an ion of chlorine). "Sulfur trioxide, comma" may be written,



When a repetition of the signs for the raised plus and minus occurs, it is not necessary to repeat dot 3. When a single or repeated plus or

minus sign is followed by a mark of punctuation, the latter should be preceded by dot 3.

Examples:

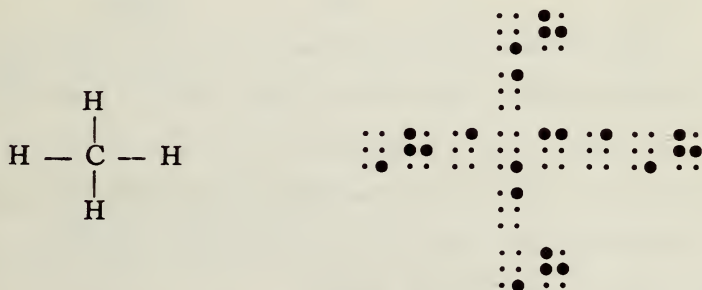


IV. The bonds which are supposed to tie two atoms together are represented by the Braille signs of the seventh line of Standard English Braille (see page 6).

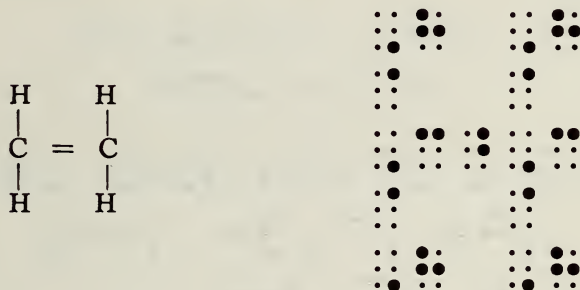
Dot 4 denotes a single bond, dots 4-5 a double bond, dots 4-5-6, a

triple bond, dot 5 a quadruple bond, and so on. The sign of these bonds are placed between the atoms which they tie together. For example, $\begin{smallmatrix} \cdot\cdot & \bullet\bullet & \cdot\cdot & \cdot\cdot & \bullet\bullet & \cdot\cdot & \cdot\cdot & \bullet\bullet \\ \bullet\bullet & \bullet\bullet & \cdot\cdot & \bullet\bullet & \bullet\bullet & \cdot\cdot & \bullet\bullet & \bullet\bullet \end{smallmatrix}$ represents one atom of oxygen tied to each of two atoms of hydrogen by a single bond.

A single atom of carbon tied to each of four atoms of hydrogen is written as follows:



The structural formula for ethylene, C_2H_4 , may be written:



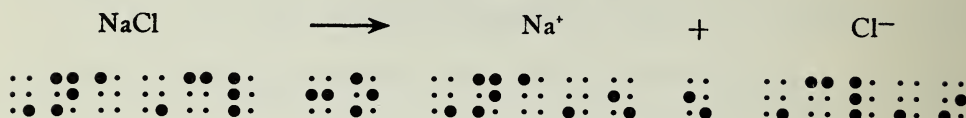
The structural formula for acetylene, C_2H_2 , may be written:



Do not confuse the double bond with the equality sign, the ink-print formation is the same but the Braille is not.

V. A single arrow to the right is indicated by dots 2-5 followed by dots 1-3-5. For example, $(\longrightarrow) \begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$

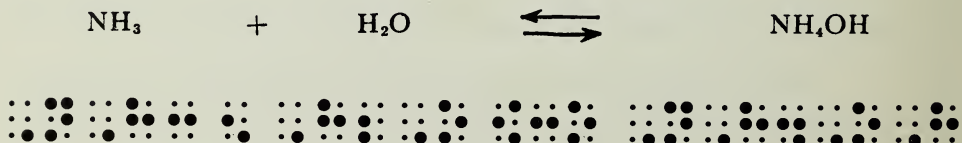
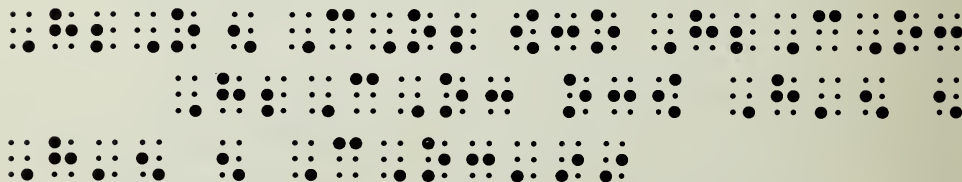
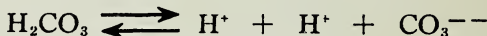
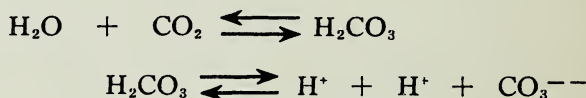
This sign must be preceded and followed by a space as:



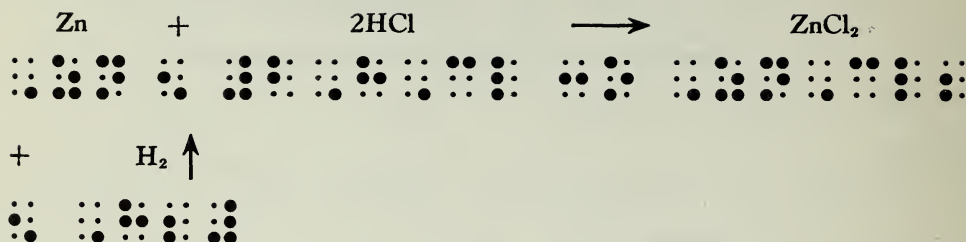
Should occasion arise for the use of an arrow to the left, it should be indicated by dots 2-4-6 followed by dots 2-5 as: (\leftarrow) $\begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$

A double arrow is indicated by dots 2-4-6, 2-5, and 1-3-5 if the upper arrow points to the left as $\left(\overleftarrow{\hspace{1.5cm}}\right) \begin{smallmatrix} \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \end{smallmatrix}$; a double arrow is indicated by dots 1-3-5, 2-5, and 2-4-6 if the upper arrow points to the right as $\left(\overrightarrow{\hspace{1.5cm}}\right) \begin{smallmatrix} \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \end{smallmatrix}$

Example:



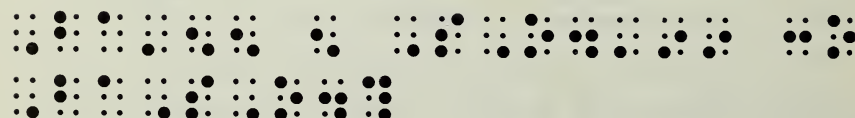
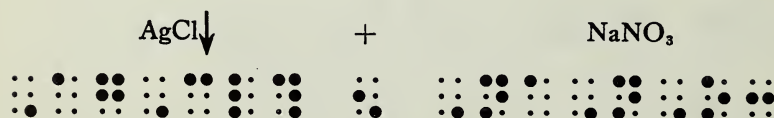
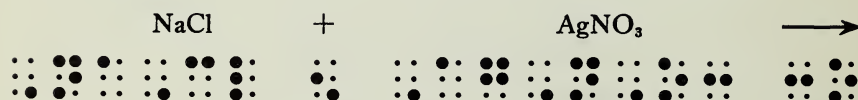
Example :



A single arrow downward, is indicated by dots 1-4-5-6, $(\downarrow) \cdot\cdot$.

This sign must be written immediately following the symbol to which it refers.

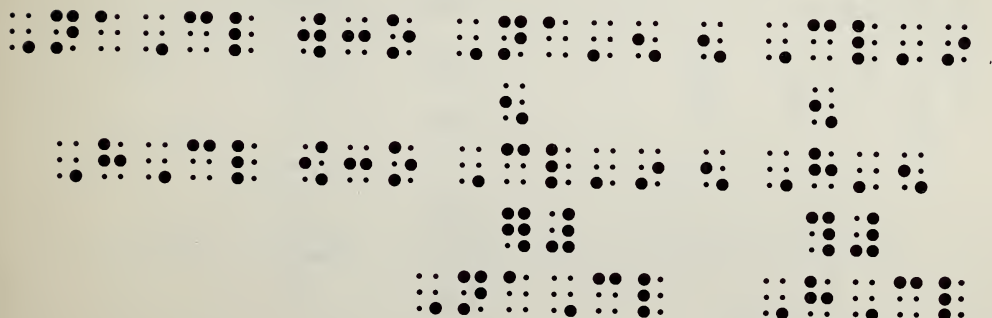
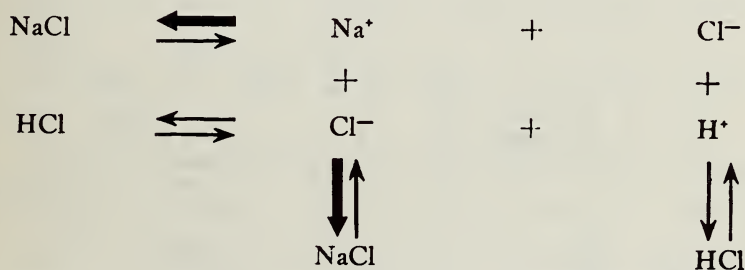
Examples :



A double arrow (upward and downward or downward and upward) is indicated by dots 3-4-5-6 followed by dots 1-4-5-6 or dots 1-4-5-6 followed by dots 3-4-5-6. If the upward arrow precedes the downward arrow, it is written $\left(\begin{smallmatrix} \uparrow \\ \downarrow \end{smallmatrix}\right) \begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$; if the downward arrow precedes the upper, it is written $\left(\begin{smallmatrix} \downarrow \\ \uparrow \end{smallmatrix}\right) \begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$.

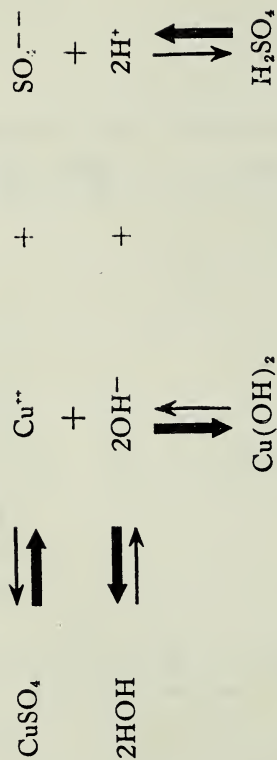
A double arrow (downward and upward) *heavy downward*, is indicated by dots 1-2-4-5-6 followed by dots 3-4-5-6 as $\left(\downarrow\uparrow\right) \begin{smallmatrix} \bullet\bullet \\ \bullet\bullet \end{smallmatrix} \begin{smallmatrix} \bullet\bullet \\ \bullet\bullet \end{smallmatrix} \bullet$.

These signs may be used as follows:



A double arrow (downward and upward) heavy upward, should be indicated by dots 1-4-5-6 followed by dots 2-3-4-5-6 as (↓↑) .

It may be used as follows:



VI. Dots 1-6, $\begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$ denote that all signs following are written on the next lower line, this is generally used to denote a change from the regular line to the sub-line but may be used, when necessary, to denote a change from any line to the one lower. The change from the regular to the sub-line remains until the sign is cancelled by dots 3-4 (see Rule VII), the capital sign or a space. The sign should not be cancelled by dots 3-4 when cancellation is possible by means of the capital sign or a space.

Examples:



The sign is not needed to express a sub-line numeral represented by the Braille formations of the fifth line and covered by Rule I. It is preferable, however, to use the sign if the sub-line numeral precedes the formula, such numerals should be preceded by the numeral sign and the signs of the first line of Braille. (See page 6 for the lines of Braille signs.)

Examples:



See Rule VII.

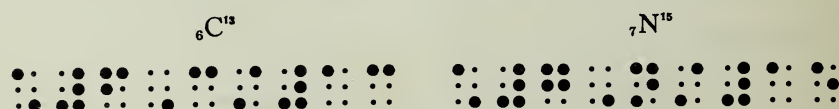
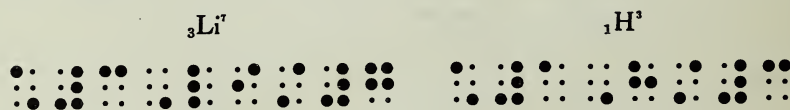
Should the symbols in the lower line contain a capital letter, the change to the lower line should be indicated by a repetition of dots 1-6, $\begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$, which denotes that the change to a lower line will be cancelled by either dots 3-4 (see Rule VII) or a space and that the capital sign will not take its usual value of cancellation. The double sign is not, however, needed for a dropped single capital letter.

Examples:



VII. The sign dots 3-4, $\begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$, denotes a change to an upper line (this is generally used to denote a change from the regular line to the upper or raised line, but may be used when necessary to denote a change from any line to the next higher one. The change from the regular line to the upper or raised line remains until the sign dots 3-4 is cancelled by dots 1-6 (see Rule VI), the capital sign or a space.

Examples:



The sign should not be cancelled by dots 1-6 when cancellation is possible by means of the capital sign or space.

Should the symbols in the upper or raised line contain a capital letter, the change to the upper line should be indicated by a repetition of dots 3-4, $\begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$, which denotes that the change to the upper line will be cancelled by either dots 1-6 (see Rule VI) or a space, and that the capital sign will not take its usual value of cancellation. The double sign is not, however, needed for a single raised capital letter.

Example:

CH (representing hydrogen ion concentration) may be written



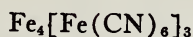
VIII. For the parenthesis, the signs $\begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$ may be used and need not be preceded by dot 3 (see Rule III). A sub-line numeral may follow this sign without dots 1-6, the sign denoting a change to a lower line.

Examples:



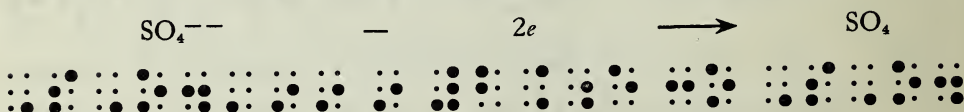
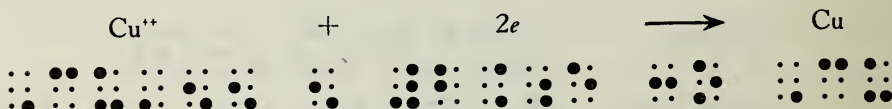
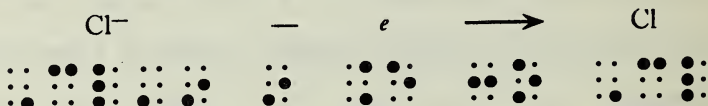
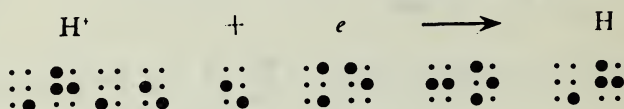
IX. For the use of ink-print brackets in connection with chemical formulae, the signs $\begin{smallmatrix} \bullet & \bullet \\ \bullet & \bullet \end{smallmatrix}$ may be used and need not be preceded by dot 3 (see Rule III). These may also be followed by a sub-line numeral without dots 1-6, the sign denoting a change to a lower line.

Example:



X. An electron (e) may be expressed by the sign $\ddot{\bullet} \ddot{\bullet}$. When the sign for the electron is preceded by a numeral, it is better to use a letter sign. While the decimal point does not appear in chemical equations, it does appear in problems in chemical textbooks and for that reason it is less confusing for the student if the letter sign is used when the electron is preceded by a numeral. The letter sign should also be used when the ink-print symbol for the electron does not appear in an equation but is written as part of the text.

Examples :



XI. Should the proportion sign be needed, the usual mathematical sign should be used, i.e., $:$ $\frac{\cdot}{\cdot}\frac{\cdot}{\cdot}$, $::$ $\frac{\cdot}{\cdot}\frac{\cdot}{\cdot}$ $\frac{\cdot}{\cdot}\frac{\cdot}{\cdot}$. In chemistry texts, the sign should be preceded and followed by a space. (The second proportion sign is recognized as such since it follows the single proportion sign; it cannot be mistaken for the equality sign.)

Example:

$$245 : 96 :: x \text{ grams} : 20 \text{ grams}$$

Figure 1 displays a set of 20 dot patterns arranged in two rows of ten. The top row contains patterns for digits 0 through 9, and the bottom row contains patterns for digits 10 through 19. Each pattern is a unique arrangement of black dots on a white background, designed for a dot-matrix display.

In the writing of equations, the letter x need not be preceded by the letter sign.

Example:

$$x = 364.3 \text{ grams}$$

XII. The mathematical multiplication and division signs, \cdot \div , may also be used when needed. They should always be preceded and followed by a space.

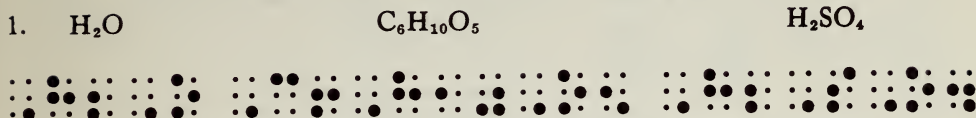
Examples:

$$.715 \div .09$$
$$2 \times 56$$

• • • • • • • • • • • • • • • • •

XIII. When it becomes necessary to divide an equation or formula at the end of a line, the division should be made, if possible, when a space occurs in the Braille. The continuation of the equation or formula on another line would not be read as another one for, if two appeared together, they would be separated by a mark of punctuation. When this method is impossible or entails a great loss of space, the formulae—and particularly those which appear in organic chemistry—should be divided by the usual Braille hyphen which need not be preceded by dot 3. The numeral sign should not be repeated when an integral number is divided at the end of a line.

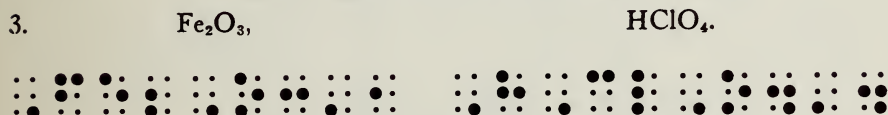
FURTHER EXAMPLES OF CHEMICAL EQUATIONS



Note the lower numeral is represented by the signs of the fifth line. The sign denoting a change to a lower line is not used neither is the numeral sign. (See Rule I.)



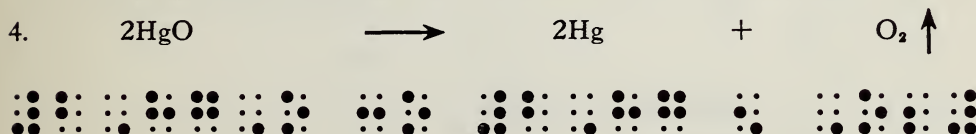
Notice, in the examples shown above, that the numeral on the regular line is expressed as in Standard English Braille.



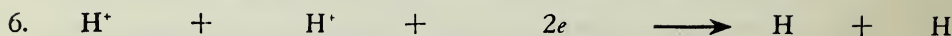
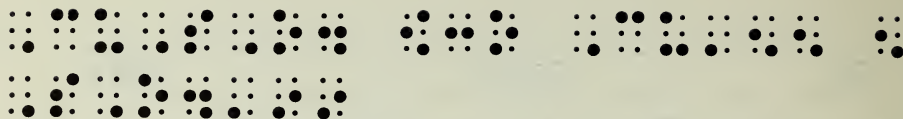
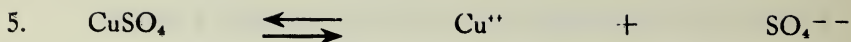
What is KClO_3 ?



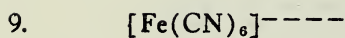
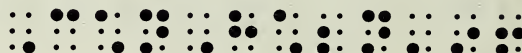
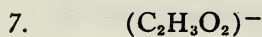
Note that the mark of punctuation is preceded by dot 3. (See Rule III.)



Note the arrow at the end is not preceded by a space. (See Rule V.)



Note the spacing of the various plus signs.



Note the treatment of the sub-line numeral following the parenthesis.



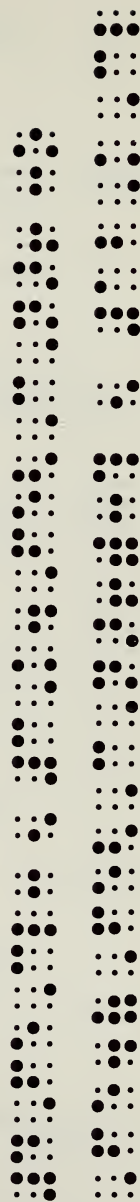
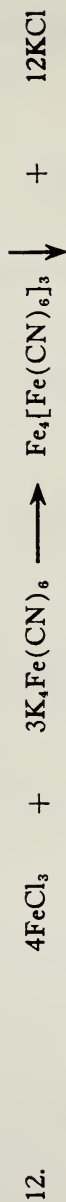
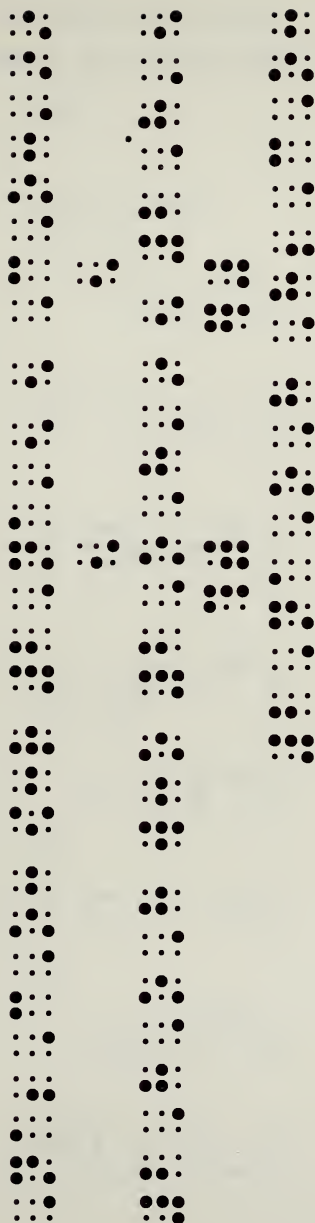
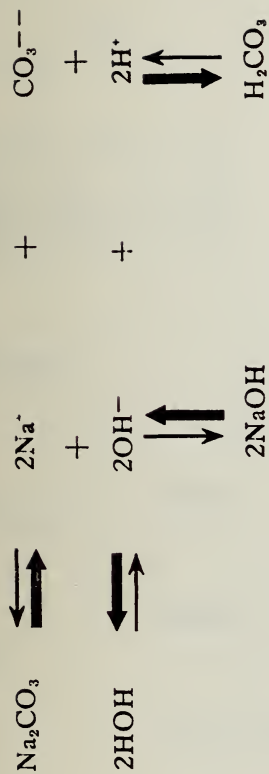


TABLE OF BRAILLE CHEMICAL NOTATIONS FOR AMERICAN TEXTS

*Example of use in
American ink-print*

Braille Character

Source

1. CO (Carbon monoxide)

⠠⠠⠠⠠⠠⠠

Recommended American use of English system but using *capital* and dropping sub-one after single atoms.

Co (Cobalt)

⠠⠠⠠⠠⠠

H₂O

⠠⠠⠠⠠⠠⠠⠠

2. H⁺

⠠⠠⠠⠠⠠⠠

English

3. Cl⁻

⠠⠠⠠⠠⠠⠠⠠

English

4. H—O—H

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

English

5. C=O

⠠⠠⠠⠠⠠⠠⠠

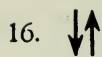
English

6. —C≡C—

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

English

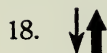
7.	→		German (Must always be preceded and followed by a space.)
8.	←		German “ “
9.	↔		German “ “
10.	↔		M. S. Loomis “ “
11.	↔		P. C. Mitchell “ “ N. Y. I. E. B.
12.	↔		P. C. Mitchell “ “ N. Y. I. E. B.
13.	↑		P. C. Mitchell N. Y. I. E. B.
14.	↓		P. C. Mitchell N. Y. I. E. B.
15.	↕		M. S. Loomis



M. S. Loomis



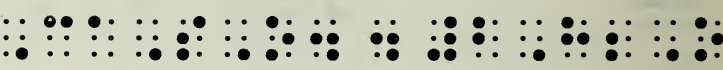
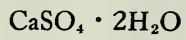
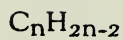
M. S. Loomis



M. S. Loomis



M. S. Loomis



(representing an electron)

M. S. Loomis

